PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 07 February 2001 (07.02.01)	
International application No. PCT/NL00/00374	**Applicant's or agent's file reference** P48553PC00
International filing date (day/month/year) 31 May 2000 (31.05.00)	**Priority date** (day/month/year) 01 June 1999 (01.06.99)
Applicant VAN HALTEREN, Aart, Zeger et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

21 December 2000 (21.12.00)

[ ] in a notice effecting later election filed with the International Bureau on:

_____

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Zakaria EL KHODARY
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
P48553PC00		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/NL 00/ 00374	31/05/2000	01/06/1999
Applicant		
MICROTRONIC NEDERLAND BV		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [ ] the text is approved as submitted by the applicant.

   [X] the text has been established by this Authority to read as follows:

   MOUNTING OF THE COIL IN AN ELECTROACOUSTIC TRANSDUCER

5. With regard to the **abstract,**

   [ ] the text is approved as submitted by the applicant.

   [X] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 3b

   [ ] as suggested by the applicant.

   [X] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

tional application No.
PCT/NL 00/ 00374

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

An electroacoustic transducer comprising a case accommodating an armature with at least two armature legs (6); a coil (9) with an air gap, which is fitted around one armature leg (6a); a magnetic element (7,8) with an air gap which is likewise fitted around the one armature leg, with the air gap of the coil and that of the magnetic element being located in line with each other; a diaphragm (4); and a connecting element (5) which couples a free end of the one armature leg to the diaphragm; and a printed circuit board (14) with terminals (15) for the wires of the coil and for external connections. According to the invention, the coil is attached to the printed circuit board by an end face thereof which is located essentially perpendicularly to the longitudinal axis of the air gap, and the printed circuit board is provided with at least one recess adapted to cooperate with a leg of the armature. Through these measures, the coil can be positioned symmetrically with respect to the armature leg with very high accuracy.

INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted]NL 00/00374

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04R11/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 193 116 A (MOSTARDO AUGUST F) 9 March 1993 (1993-03-09) column 3, line 51 - line 68; figures 1,2	1
A	WO 91 10243 A (KNOWLES ELECTRONICS CO) 11 July 1991 (1991-07-11) cited in the application page 4, line 18 -page 5, line 6; figures 1,2	1
A	EP 0 851 710 A (MICROTRONIC NEDERLAND BV) 1 July 1998 (1998-07-01) cited in the application column 6, line 27 - line 30; figure 2	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 February 2001	15/02/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Anderson, A

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte[redacted]al Application No
PC[redacted]L 00/00374

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5193116	A	09-03-1993	NONE		
WO 9110243	A	11-07-1991	AT	135135 T	15-03-1996
			AT	158102 T	15-09-1997
			AU	648763 B	05-05-1994
			AU	6758690 A	24-07-1991
			CA	2071927 A	22-06-1991
			DE	69025771 D	11-04-1996
			DE	69031432 D	16-10-1997
			DE	69031432 T	19-03-1998
			DK	505382 T	10-06-1996
			DK	686985 T	30-03-1998
			EP	0505382 A	30-09-1992
			EP	0686985 A	13-12-1995
			JP	2957698 B	06-10-1999
			JP	5502550 T	28-04-1993
			US	5610989 A	11-03-1997
			US	5708721 A	13-01-1998
EP 0851710	A	01-07-1998	NL	1004877 C	03-08-1998
			NL	1004877 A	25-06-1998
			US	6078677 A	20-06-2000

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

3

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
P48553PC00		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NL00/00374	31/05/2000	01/06/1999

International Patent Classification (IPC) or national classification and IPC
H04R11/00

Applicant
MICROTRONIC NEDERLAND BV et al.

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21/12/2000	30.04.2001

Name and mailing address of the international preliminary examining authority:

European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized officer

Haertle, M

Telephone No. +49 89 2399 8955

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NL00/00374

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-5 as originally filed

Claims, No.:

1-7 as originally filed

Drawings, sheets:

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-7
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-7
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-7
	No:	Claims	

2. Citations and explanations
   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

Item V.2.

1. Claim 1 : Novelty

   The nearest state of the art is D1:WO 91 10243 A (KNOWLES ELECTRONICS CO) 11 July 1991 (1991-07-11) cited in the application.

   None of the documents cited in the International Search Report nor the nearest state of the art discloses an electroacoustic transducer comprising a coil attached to the printed circuit board by an end face thereof, which is located essentially perpendicularly to the longitudinal axis of the air gap, and the printed circuit board being provided with an opening which corresponds with the air gap of the coil.

2. Claim 1 : Inventive Step

   The combination of features according to Claim 1 cannot be obviously derived from the available state of the art or from the common knowledge of the person skilled in art.

3. Claims 2 to 7 :

   Claims 2 to 7 contain particular embodiments of the subject-matter of Claim 1 and meet therefore the regulations of Art. 33 (2), 33 (3) PCT.

Item VII.

1. The features of the Claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 December 2000 (07.12.2000)

PCT

(10) International Publication Number
WO 00/74436 A3

(51) International Patent Classification[7]: H04R 11/00

(21) International Application Number: PCT/NL00/00374

(22) International Filing Date: 31 May 2000 (31.05.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1012208 1 June 1999 (01.06.1999) NL

(71) Applicant *(for all designated States except US)*: **MICROTRONIC NEDERLAND B.V.** [NL/NL]; Zekeringstraat 9, NL-1014 BM Amsterdam (NL).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **VAN HALTEREN, Aart, Zeger** [NL/NL]; Oud Raeffeldamweg 2, NL-1447 EG Hobrede (NL). **WILMINK, Engbert** [NL/NL]; Giststraat 16, NL-2611 PT Delft (NL). **DOLLEMAN, Hendrik** [NL/NL]; Franciscanenstraat 10, NL-1566 LD Assendelft (NL). **VAN HAL, Paul, Christiaan** [NL/NL]; Cole Porterhof 61, NL-1628 TJ Hoorn (NL).

(74) Agent: **PRINS, A., W.**; Vereenigde, Nieuwe Parklaan 97, NL-2587 BN The Hague (NL).

(81) Designated States *(national)*: JP, US.

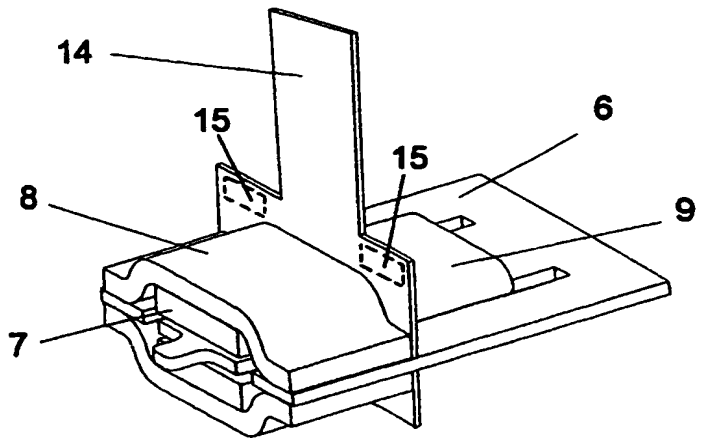
(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published:
— *With international search report.*

(88) Date of publication of the international search report:
12 July 2001

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MOUNTING OF THE COIL IN AN ELECTROACOUSTIC TRANSDUCER



(57) Abstract: An electroacoustic transducer comprising a case accommodating an armature with at least two armature legs (6); a coil (9) with an air gap, which is fitted around one armature leg (6a); a magnetic element (7, 8) with an air gap which is likewise fitted around the one armature leg, with the air gap of the coil and that of the magnetic element being located in line with each other; a diaphragm (4); and a connecting element (5) which couples a free end of the one armature leg to the diaphragm; and a printed circuit board (14) with terminals (15) for the wires of the coil and for external connections. According to the invention, the coil is attached to the printed circuit board by an end face thereof which is located essentially perpendicularly to the longitudinal axis of the air gap, and the printed circuit board is provided with at least one recess adapted to cooperate with a leg of the armature. Through these measures, the coil can be positioned symmetrically with respect to the armature leg with very high accuracy.

WO 00/74436 A3

INTERNATIONAL SEARCH REPORT

International Application No
PC[redacted] 00/00374

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04R11/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 193 116 A (MOSTARDO AUGUST F) 9 March 1993 (1993-03-09) column 3, line 51 - line 68; figures 1,2	1
A	WO 91 10243 A (KNOWLES ELECTRONICS CO) 11 July 1991 (1991-07-11) cited in the application page 4, line 18 -page 5, line 6; figures 1,2	1
A	EP 0 851 710 A (MICROTRONIC NEDERLAND BV) 1 July 1998 (1998-07-01) cited in the application column 6, line 27 - line 30; figure 2	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 February 2001	15/02/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Anderson, A

1

INTERNATIONAL SEARCH REPORT

.forma[redacted]n patent family members

Inte[redacted]nal Application No
PC[redacted]NL 00/00374

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5193116	A	09-03-1993	NONE		
WO 9110243	A	11-07-1991	AT	135135 T	15-03-1996
			AT	158102 T	15-09-1997
			AU	648763 B	05-05-1994
			AU	6758690 A	24-07-1991
			CA	2071927 A	22-06-1991
			DE	69025771 D	11-04-1996
			DE	69031432 D	16-10-1997
			DE	69031432 T	19-03-1998
			DK	505382 T	10-06-1996
			DK	686985 T	30-03-1998
			EP	0505382 A	30-09-1992
			EP	0686985 A	13-12-1995
			JP	2957698 B	06-10-1999
			JP	5502550 T	28-04-1993
			US	5610989 A	11-03-1997
			US	5708721 A	13-01-1998
EP 0851710	A	01-07-1998	NL	1004877 C	03-08-1998
			NL	1004877 A	25-06-1998
			US	6078677 A	20-06-2000

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 December 2000 (07.12.2000)

PCT

(10) International Publication Number
WO 00/74436 A2

(51) International Patent Classification[7]: H04R 9/00

(21) International Application Number: PCT/NL00/00374

(22) International Filing Date: 31 May 2000 (31.05.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1012208 1 June 1999 (01.06.1999) NL

(71) Applicant *(for all designated States except US)*: **MICROTRONIC NEDERLAND B.V.** [NL/NL]; Zeeringstraat 9, NL-1014 BM Amsterdam (NL).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **VAN HALTEREN, Aart, Zeger** [NL/NL]; Oud Raeffeldamweg 2, NL-1447 EG Hobrede (NL). **WILMINK, Engbert** [NL/NL]; Giststraat 16, NL-2611 PT Delft (NL). **DOLLEMAN, Hendrik** [NL/NL]; Franciscanenstraat 10, NL-1566 LD Assendelft (NL). **VAN HAL, Paul, Christiaan** [NL/NL]; Cole Porterhof 61, NL-1628 TJ Hoorn (NL).

(74) Agent: **PRINS, A., W.**; Vereenigde, Nieuwe Parklaan 97, NL-2587 BN The Hague (NL).

(81) Designated States *(national)*: JP, US.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published:
— *Without international search report and to be republished upon receipt of that report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 00/74436 A2

(54) Title: COIL CONSTRUCTION FOR AN ELECTROACOUSTIC TRANSDUCER

(57) Abstract: An electroacoustic transducer comprising a case accommodating an armature with at least two armature legs; a coil with an air gap, which is fitted around one armature leg; a magnetic element with an air gap, which is likewise fitted around the one armature leg, with the air gap of the coil and that of the magnetic element being located in line with each other; a diaphragm; and a connecting element which couples a free end of the one armature leg to the diaphragm; and a printed circuit board with terminals for the wires of the coil and for external connections. According to the invention, the coil is attached to the printed circuit board by an end face thereof which is located essentially perpendicularly to the longitudinal axis of the air gap, and the printed circuit board is provided with at least one recess adapted to cooperate with a leg of the armature. Through these measures, the coil can be positioned symmetrically with respect to the armature leg with very high accuracy.

Title: Coil construction for an electroacoustic transducer.

This invention relates to an electroacoustic transducer comprising a case accommodating an armature with at least two armature legs; a coil with an air gap, which coil is fitted with the air gap around an armature leg; a magnetic element with an air gap, which magnetic element is likewise fitted with the air gap around the one armature leg, the air gap of the coil and that of the magnetic element being located substantially in line with each other; a diaphragm; a connecting element which couples a free end of the one armature leg to the diaphragm; and a printed circuit board with terminals for the wires of the coil and for external connections, the coil being attached to the printed circuit board.

Such transducers find application especially, but not exclusively, in hearing aids.

Such a transducer is known, for instance, from WO 91/10243. This publication recognizes the problems in manipulating the lead wires of the coil. These wires are often microscopically thin and must be connected to more robust connecting wires connecting the coil to the further circuits in the hearing aid.

In this prior art reference, it is proposed as a solution to attach the coil, preferably automatically, directly upon winding, to terminal areas of a flexible printed circuit board, whereby first the lead wires of the coil are attached, for instance by welding or soldering, to the terminal areas of the printed circuit board and subsequently a side face of the coil is attached, for instance by adhesion, to the printed circuit board. The printed circuit board further has additional terminal areas to which the external connecting wires can be attached, for instance by soldering.

A flexible printed circuit board has the advantage that it can be laid in the case in any desired manner. It is often also possible, however, to use a printed circuit board from rigid material.

A problem in existing coil constructions which are not already mounted on a printed circuit board, and in coil constructions which, as in the technique according to WO 91/10243, have already been pre-mounted on a, possibly flexible, printed circuit board, is that positioning the coil with respect to the other parts of the transducer, in particular with respect to the arm of the armature and with respect to the air gap of the magnetic element, is a painstaking, labor-intensive and time-consuming and hence costly activity.

The invention contemplates presenting a solution to this problem and to that end provides a transducer of the above-mentioned type, characterized in that the coil is attached to the printed circuit board by an end face thereof, which is located essentially perpendicularly to the longitudinal axis of the air gap, and that the printed circuit board is provided with an opening which corresponds with the air gap of the coil. Preferably, the printed circuit board is provided with at least one recess adapted to cooperate with at least one other leg of the armature.

The invention further provides a coil construction for an electromagnetic transducer, comprising a coil with an air gap and a printed circuit board with terminals for wires of the coil and external connections, characterized in that the coil is attached to the printed circuit board by an end face thereof, which is located essentially perpendicularly to the longitudinal axis of the air gap, and that the printed circuit board is provided with an opening which corresponds with the air gap of the coil.

The invention is based on the insight that the printed circuit board can be fixedly connected to the armature and that, as a result, a coil fixedly connected to the printed circuit board can be accurately positioned with respect to the armature. By means of an automatic manufacturing process, for instance as elucidated in WO 91/10243, it is possible to position the coil very accurately with respect to the printed circuit board and to attach it thereto, for instance by means of adhesive. When thereupon the printed

circuit board can be positioned with respect to the armature very accurately, the position of the coil with respect to the armature is thereby determined very accurately as well. The operation required for this purpose consists in sliding the printed circuit board over the armature, which is an operation which can be performed simply and fast. The invention thus provides an excellent solution to the above-outlined problem.

Hereinbelow, the invention will be further explained on the basis of an exemplary embodiment, with reference to the drawings. In the drawings:

Fig. 1 is a cross section of an electromagnetic transducer known per se;

Fig. 2a is a perspective view of a coil mounted on a printed circuit board, for an electromagnetic transducer according to the invention;

Fig. 3a is an exploded view of a magnetic body, a coil construction according to the invention, and an armature; and

Fig. 3b shows the parts shown in Fig. 3a in assembled condition.

In elucidation of the use of the coil construction according to the invention in an electroacoustic transducer, Fig. 1 schematically shows a transducer known per se for use in a hearing aid.

The transducer comprises a case 1 with an upper case portion 1a and a lower case portion 1b. The interior of the case communicates with the surroundings via a snout 3. In the case, a diaphragm 4 is fitted in such a manner that it can move freely relative to the case, for instance in the manner described in Dutch patent application 1004877. The diaphragm communicates via a so-called reed 5 with the end of a central armature leg 6a of an armature 6. In this case, the armature is E-shaped, as appears more clearly from Fig. 3, but may also be U-shaped.

Provided around the armature leg are a magnet 7, which is accommodated in a pole piece 8, and a coil 9. Both the magnet and the coil have a central opening disposed around the armature leg 6a, such that the

armature leg can move freely in these openings. Between the coil and the magnet/pole piece combination, an adhesive film 2 is provided to fix these parts with respect to each other. The coil lead wires, not shown, are passed through the case to a printed circuit board 10 with terminals 11 to which the coil lead wires and the external connecting wires can be attached, for instance by soldering.

Electrical signals fed via the lead wires of the coil provide for a movement of the armature leg 6a, which movement is transmitted via the reed to the diaphragm 4, which converts the movement into the sound signals to be perceived via the snout 3.

It will be clear that it is a painstaking and labor-intensive activity to position the coil in the transducer shown in Fig. 1 and to connect the coil wires to the print 10.

Fig. 2 schematically shows a view of the coil construction according to the invention. The core-free coil 9 may be provided, on the circumference thereof, with terminals 12 for the coil lead wires 13a, from which terminals 12 further wires 13b lead to the printed circuit board 14. It is equally possible, however, to connect the coil lead wires 13a directly to the terminal areas 15 on the printed circuit board 14, which may be flexible or rigid, as desired. The coil body 9 is attached, for instance by adhesion, to the printed circuit board through a coil end face, which is located essentially perpendicularly to the longitudinal axis of the central opening in the coil. This can be done with great accuracy in an automatic manner.

The printed circuit board further comprises terminal areas, not shown, for attaching connections to the exterior of the transducer. These further terminal areas are connected through print tracks to the terminal areas 15, or are part thereof.

An elegant solution for providing a connection between the printed circuit board 14 and the exterior of the transducer is to provide pins which at one end are connected, for instance by soldering, to the terminal areas on

the printed circuit board 14 and which project outside through openings in the case wall to be connected to a printed circuit board present there, having further electronics for signal processing. Such pins can be rigid or slightly flexible and are to be passed, insulated, through the openings provided in the case wall for that purpose. In Fig. 3a two of such pins 18 are schematically shown.

As clearly shown in Figs. 3a and b, the printed circuit board 14 is provided with an opening 16 and recesses 17a, b, while the opening 16 corresponds with the air gap of the coil and can be slid over the armature leg 6a. The opening 16 is so dimensioned that the free movement of the armature leg is not hampered. The recesses 17a and b are slid over the two other legs 6b and 6c of the E-shaped armature 6. Naturally, the recesses 17a, b, instead of being slotted, can also be closed all round or have any other shape that is suitable to be slid over the armature legs 6b, c.

The recesses 17a and b fit accurately over the armature legs 6b and 6c, so that the position of the printed circuit board 14 with respect to the armature is very accurate. Because positioning the coil 9 with respect to the printed circuit board can also be done very accurately, the problem of positioning the coil body with respect to the central armature leg has been resolved in a simple manner.

It will be clear that the principle according to the invention is also applicable in U-shaped armatures, that is, an armature where either of the legs 6b or 6c is absent.

It will also be clear that there are other possibilities of accurately positioning the printed circuit board with respect to the armature than by way of recesses 17a and b.

CLAIMS

1. An electroacoustic transducer comprising a case accommodating an armature with at least two armature legs; a coil with an air gap, which coil is fitted with the air gap around one armature leg; a magnetic element with an air gap, which magnetic element is likewise fitted with the air gap around the one armature leg, the air gap of the coil and that of the magnetic element being located in line with each other; a diaphragm; a connecting element which couples a free end of the one armature leg to the diaphragm; and a printed circuit board with terminals for the wires of the coil and for external connections, the coil being attached to the printed circuit board, characterized in that the coil is attached to the printed circuit board by an end face thereof, which is located essentially perpendicularly to the longitudinal axis of the air gap, and that the printed circuit board is provided with an opening which corresponds with the air gap of the coil.

2. An electroacoustic transducer according to claim 1, characterized in that the printed circuit board is further provided with at least one recess adapted to cooperate with at least one other leg of the armature.

3. An electroacoustic transducer according to claim 2, characterized in that the armature is E-shaped, and that the printed circuit board is provided with two recesses, respectively cooperating with an outer leg of the armature.

4. An electroacoustic transducer according to any one of claims 1-3, characterized in that the coil is glued to the printed circuit board.

5. An electroacoustic transducer according to any one of claims 1-4, characterized in that for the purpose of external connections, pins are

connected to the terminal areas on the printed circuit board, which pins project through the wall of the case.

6. A coil construction for an electromagnetic transducer, comprising a coil with an air gap and a printed circuit board with terminals for wires of the coil and external connections, characterized in that the coil is attached to the printed circuit board by an end face thereof which is located essentially perpendicularly to the longitudinal axis of the air gap and that the printed circuit board is provided with an opening which corresponds with the air gap.

7. A coil construction according to claim 6, characterized in that the printed circuit board is provided with at least one recess along the circumferential edge thereof.

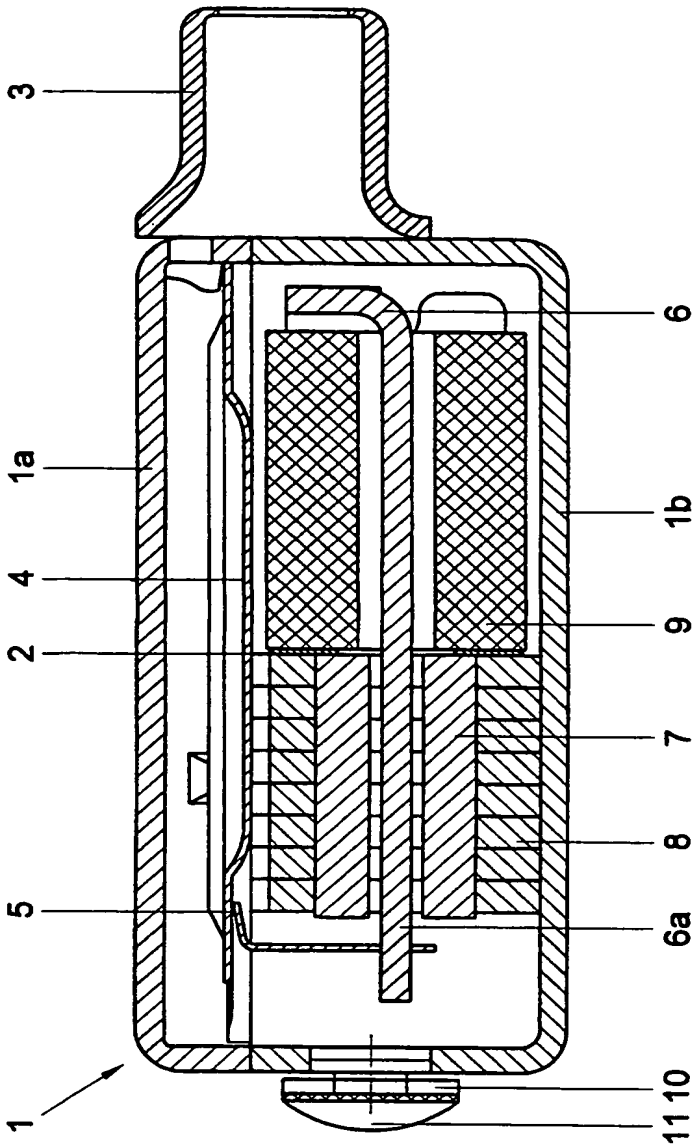


Fig. 1

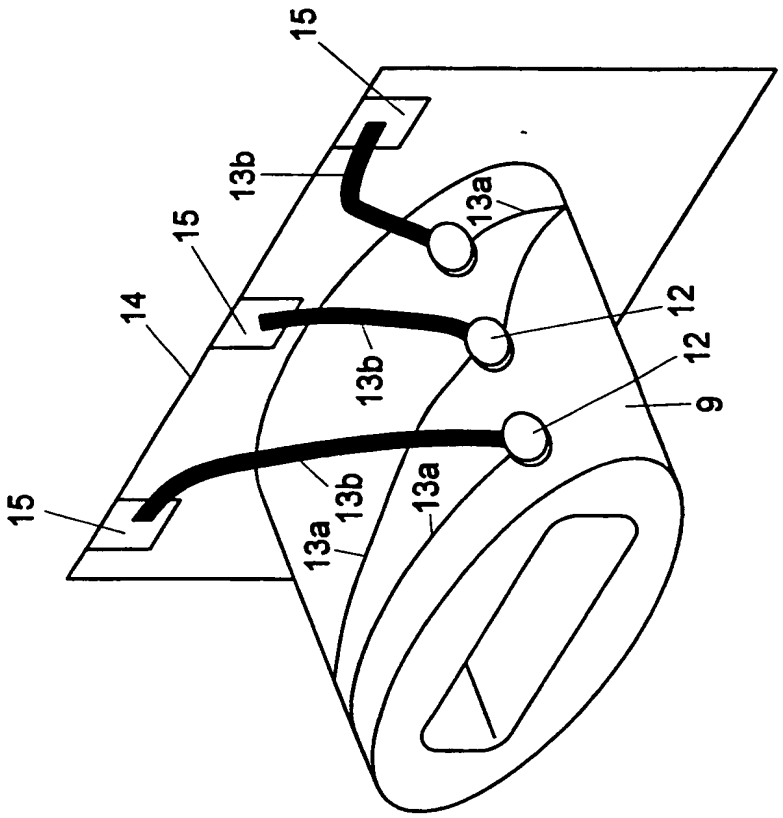


Fig. 2

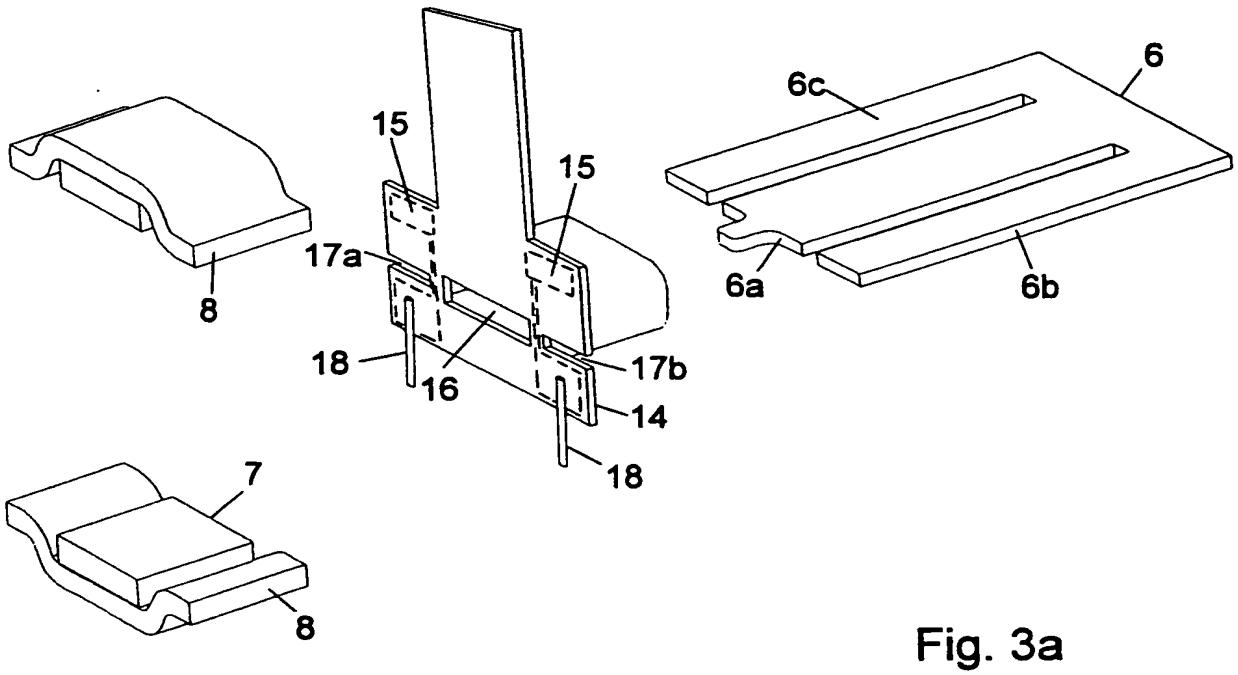


Fig. 3a

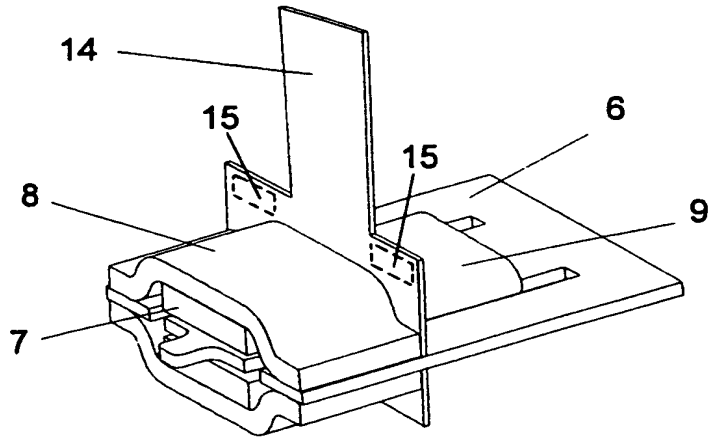


Fig. 3b

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PATENT COOPERATION TREATY

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Applicant
MICROTRONIC NEDERLAND BV et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

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